# Experimental Report: HC-5199

1. **Description of experiment**
   We performed a high-resolution powder diffraction experiment of the orthorhombic Zintl phase $Eu_5In_2Sb_6$. The material is of interest for its thermoelectric properties at high termperatures, complex magnetism and colossal magnetoresistance at low temperatures, and as an candidate topologically non-trivial (axion) insulator. We had recently found evidence for magneto-electronic phase separation below 7.5 K and wanted to evidence any coupling to the lattice. We found that ID22 at the ESRF was the only high-resolution x-ray diffraction beamline to provide a suitable cryostat.

2. **Difficulties**
   To avoid oxidation of Eu, the sample was taken to the beamline as single crystals and ground in a mortar just before the experiment. The powder was filled in a 0.3mm capillary. Regrettably, this introduced a large amount of strain, resulting in a Lorentzian peak profile wider than the intrinsic instrumental resolution.

   There was some difficulty of determining the amount of beam heating. After cooling the samples, we observed some amount of peak shift, depending on the presence of an attenuator.

   Due to thermal contraction, careful realignments were required upon cooling. We did not realize immediately that Bragg intensities depended sensitively on this realignment procedure, and we also found it difficult to achieve a reproducible realignment.

   We lost two shifts because no liquid Helium was provided on Friday, 20.5. (a bridge day between *Ascension Day* and the weekend).

3. **Deviations from original proposal**
   The experimental plan not was altered from the proposal.

4. **Achievements**
   We collect a detailed temperature dependence across the magnetic phase separation temperature (7.5 K) and the magnetic ordering temperature ($T_N$~14 K). We were not able to observe peak-splitting or evidence for phase separation. However, a preliminary structural refinement showed systematic movements in the atomic positions at $T_N$ (see Fig. 1). A detailed analysis will be necessary to confirm that the results thus inferred are not affected by extrinsic factors like the sample realignment or beam heating.

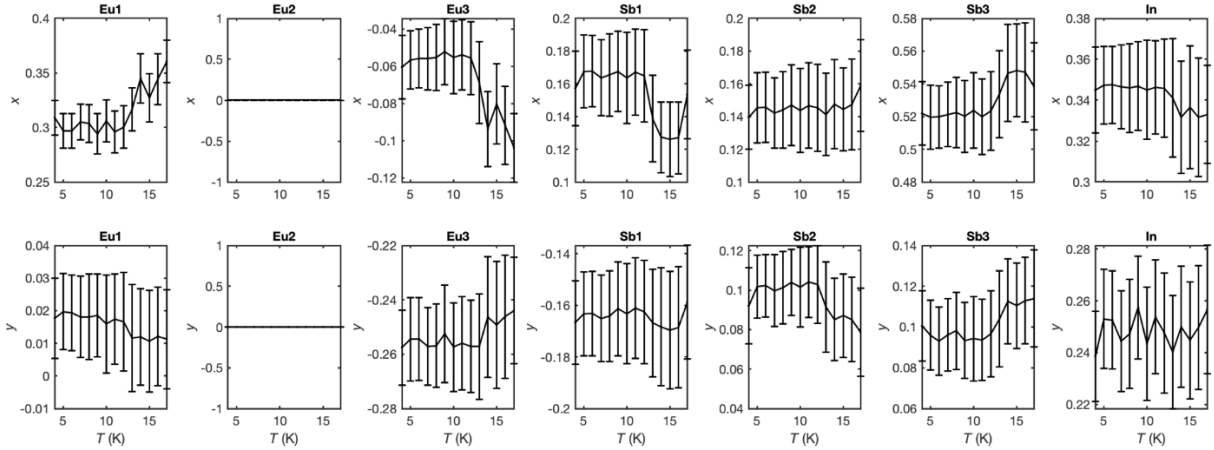


**Fig. 1** Thermal variation of ionic positions (top: x, bottom: y) obtained from a preliminary Rietveld refinement of the data. There is some evidence of the magnetoelastic coupling at $T_N$ ~ 14 K.

We are currently preparing for a detailed spectroscopic investigation of the magnetism in this temperature range. If corroborated, the observations at P22 could help the interpretation of this project and would then merit publication.

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